9. WASTE AREA GROUP 6 (EXPERIMENTAL BREEDER REACTOR I AND BOILING WATER REACTOR EXPERIMENT)

The Experimental Breeder Reactor (EBR)-I was established in the early 1950s to test the theory that a reactor could produce more fuel than it uses and became the first reactor to generate electricity. In 1953, tests conducted at the EBR-I proved that a reactor could create more fuel than it used, even while it created electricity. In 1963, reactor operations at EBR-I ceased.

Less than a mile from EBR-I at the Boiling Water Reactor Experiment (BORAX) area, five reactor experiments were conducted between 1953 and 1964. These experiments began with BORAX-I, which was used to demonstrate the feasibility of boiling water reactors. The BORAX-I reactor was intentionally destroyed in 1954 to determine its inherent safety under extreme conditions. It was then buried in place.

In late 1954, another BORAX facility was constructed a few hundred feet northeast of BORAX-I. Over the next 10 years, three reactors (BORAX-II, -III, and -IV) shared the same reactor vessel, but the experiments used different fuel designs and core configurations. The BORAX-V reactor also shared the same facility but used a new reactor vessel and core system.

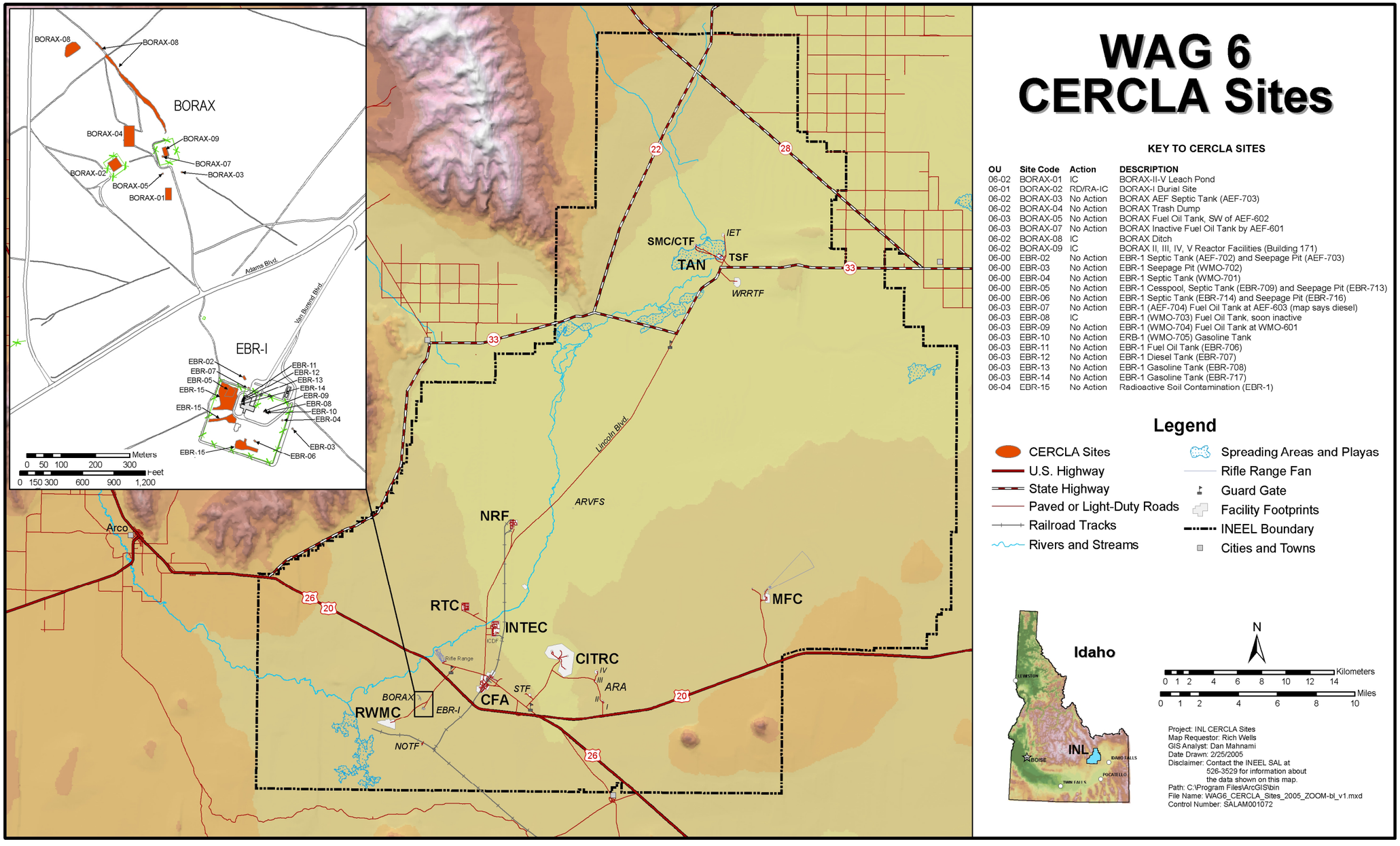
Past operations and support activities at the EBR-I and BORAX areas resulted in the release of radioactive contamination. To facilitate cleanup of the contamination, EBR-I and BORAX were designated as Waste Area Group (WAG) 6 per a federal facility agreement and consent order (FFA/CO) (DOE-ID 1991). Because they are located within 1 mi of each other and have similar operational backgrounds and sources of contamination, the WAG 6 boundary encompasses both facilities and the immediately adjacent surface and subsurface areas. Table 9-1 summarizes the contaminants of concern (COCs) and remediation goals for WAG 6 sites where a remedial action was performed.

Table 9-1. COCs at WAG 6.

Site (Site Code)	COC	Concentration	Remediation Goal
BORAX-I Burial Ground (BORAX-02)	Cs-137	95% upper confidence level (UCL) – 1,817 pCi/g	16.7 pCi/g
	Sr-90	95% UCL – 2.0 pCi/g	10.8 pCi/g
	U-235	95% UCL – 68.6 pCi/g	13.2 pCi/g
BORAX Ditch (BORAX-08)	Cs-137	Maximum – 2,130 pCi/g	16.7 pCi/g
Radioactive Soil Contamination at EBR-I (EBR-15)	Cs-137	Maximum – 14,600 pCi/g	16.7 pCi/g

The WAG 6 comprehensive remedial investigation/feasibility study (RI/FS) was incorporated into Operable Unit (OU) 10-04 in accordance with the FFA/CO. The OU 10-04 comprehensive RI/FS (DOE-ID 2001) evaluated 50 potential release sites, including 22 sites at WAG 6 (14 at EBR-I and eight at the BORAX area). Other than limited actions consisting of institutional controls, all remedial actions have been completed at the WAG 6 sites.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites at WAG 6 are illustrated in Figure 9-1. Except for the active septic system that supports the EBR-I National Historic Landmark, most of the tanks and inactive septic systems have been removed from the EBR-I area. The radionuclide-contaminated soil outside of the EBR-I building was removed in 1995.



WAG 6 CERCLA Sites

KEY TO CERCLA SITES

OU	Site Code	Action	DESCRIPTION
06-02	BORAX-01	IC	BORAX-II-V Leach Pond
06-01	BORAX-02	RD/RA-IC	BORAX-I Burial Site
06-02	BORAX-03	No Action	BORAX AEF Septic Tank (AEF-703)
06-02	BORAX-04	No Action	BORAX Trash Dump
06-03	BORAX-05	No Action	BORAX Fuel Oil Tank, SW of AEF-602
06-03	BORAX-07	No Action	BORAX Inactive Fuel Oil Tank by AEF-601
06-02	BORAX-08	IC	BORAX Ditch
06-02	BORAX-09	IC	BORAX II, III, IV, V Reactor Facilities (Building 171)
06-00	EBR-02	No Action	EBR-1 Septic Tank (AEF-702) and Seepage Pit (AEF-703)
06-00	EBR-03	No Action	EBR-1 Seepage Pit (WMO-702)
06-00	EBR-04	No Action	EBR-1 Septic Tank (WMO-701)
06-00	EBR-05	No Action	EBR-1 Cesspool, Septic Tank (EBR-709) and Seepage Pit (EBR-713)
06-00	EBR-06	No Action	EBR-1 Septic Tank (EBR-714) and Seepage Pit (EBR-716)
06-03	EBR-07	No Action	EBR-1 (AEF-704) Fuel Oil Tank at AEF-603 (map says diesel)
06-03	EBR-08	IC	EBR-1 (WMO-703) Fuel Oil Tank, soon inactive
06-03	EBR-09	No Action	EBR-1 (WMO-704) Fuel Oil Tank at WMO-601
06-03	EBR-10	No Action	ERB-1 (WMO-705) Gasoline Tank
06-03	EBR-11	No Action	EBR-1 Fuel Oil Tank (EBR-706)
06-03	EBR-12	No Action	EBR-1 Diesel Tank (EBR-707)
06-03	EBR-13	No Action	EBR-1 Gasoline Tank (EBR-708)
06-03	EBR-14	No Action	EBR-1 Gasoline Tank (EBR-717)
06-04	EBR-15	No Action	Radioactive Soil Contamination (EBR-1)

Legend

- CERCLA Sites
- U.S. Highway
- State Highway
- Paved or Light-Duty Roads
- Railroad Tracks
- Rivers and Streams
- Spreading Areas and Playas
- Rifle Range Fan
- Guard Gate
- Facility Footprints
- INEEL Boundary
- Cities and Towns

N

0 1 2 4 6 8 10 12 14 Kilometers

0 1 2 4 6 8 10 Miles

Project: INL CERCLA Sites
Map Requestor: Rich Wells
GIS Analyst: Dan Mahnami
Date Drawn: 2/25/2005
Disclaimer: Contact the INEEL SAL at 526-3529 for information about the data shown on this map.
Path: C:\Program Files\ArcGIS\bin
File Name: WAG6_CERCLA_Sites_2005_ZOOM-bl_v1.mxd
Control Number: SALAM001072

Figure 9-1. WAG 6 CERCLA sites.

The CERCLA sites related to BORAX include underground storage tanks, septic systems, a leach pond, a ditch, a trash dump, and two former reactor sites. Other than fences, none of the aboveground structures related to BORAX remain, and all of the tanks and septic systems have been removed. The BORAX leach pond was filled with clean dirt in 1985, and the radionuclide-contaminated soil in the BORAX ditch was removed in 1995. All of the waste material was removed from the BORAX trash dump in 1985. The BORAX-I, -II, -III, and -IV reactor fuels and vessel components were disposition by Argonne National Laboratory-West (ANL-W) personnel at the completion of each respective experiment. At the completion of the BORAX-V experiments, all of the reactor fuel and portions of the internal reactor were removed by ANL-W personnel for dispositioning. Later, several phases of decontamination and decommissioning removed the BORAX-V aboveground facility structures, stabilized the remaining underground structures, filled the basement with soil, and replaced concrete foundation blocks over the basement. The radionuclide-contaminated soil related to the BORAX-I reactor was remediated in 1997 (DOE-ID 1997) under the OU 5-05/6-01 ROD (INEL 1996a), and an engineered barrier cap was placed over the former reactor site.

Two RODs have been prepared for remediation activities within WAG 6. The first ROD, issued in January 1996, focused on remediation of BORAX-02. The *Record of Decision for Stationary Low Power Reactor 1 OU 5-05 & BORAX-I Burial Ground OU 6-01 and 10 No Action Sites (OU 5-01, 5-03, 5-04, and 5-11)* (INEL 1996a) required the consolidation of contaminated materials at the site of the original BORAX-I reactor burial ground and construction of a human intrusion barrier over the site (Figure 9-2). The *Record of Decision—Experimental Breeder Reactor-I/Boiling Water Reactor Experiment Area and Miscellaneous Sites, Operable Units 6-05 and 10-04* (DOE-ID 2002) provided for implementation of institutional controls at selected no-further-action sites at WAG 6. In addition, a 1995 CERCLA non-time-critical removal action addressed radionuclide-contaminated soil under OU 10-06 at the EBR-15 site and the BORAX-08 ditch (Figure 9-3), as outlined in the engineering evaluation/cost analysis for OU 10-06 (INEL 1995a).

Table 9-2 provides a chronology of the WAG 6 remedial action events.

9.1 Remedial Actions

As stated previously, two RODs have been prepared for contaminated sites within WAG 6, and one non-time-critical removal action has been performed. Based on these activities, remedial actions were conducted at three individual sites, with institutional controls being required at two of the three sites. In addition to these two sites, institutional controls have been identified for three additional WAG 6 sites. Details of the remedial actions are described below.

9.1.1 Remedy Selection

9.1.1.1 BORAX-I Burial Ground (BORAX-02). In December 1995, the *Record of Decision for Stationary Low Power Reactor 1 and Boiling Water Reactor Experiment I Burial Grounds (Operable Units 5-05 and 6-01) and 10 No Action Sites (OU 5-01, 5-03, 5-04, and 5-11)* (INEL 1996a) was signed, requiring a selected remedy calling for containment by capping with an engineered, long-term barrier composed primarily of natural material. The ROD established action levels for Cs-137 (16.7 pCi/g), U-235 (13.2 pCi/g), and Sr-90 (10.8 pCi/g).

9.1.1.2 BORAX Ditch (Site BORAX-08) and Radioactive Soil Contamination at EBR-I (Site EBR-15). The 1995 CERCLA non-time-critical removal action addressed radionuclide-contaminated soil under OU 10-06 at the radioactive soil contamination site (Site EBR-15) and the BORAX ditch (Site BORAX-08), as outlined in the engineering evaluation/cost analysis for OU 10-06 (INEL 1995a). Cleanup was based on a preliminary remediation goal concentration of 16.7 pCi/g for Cs-137 (INEL 1995a).

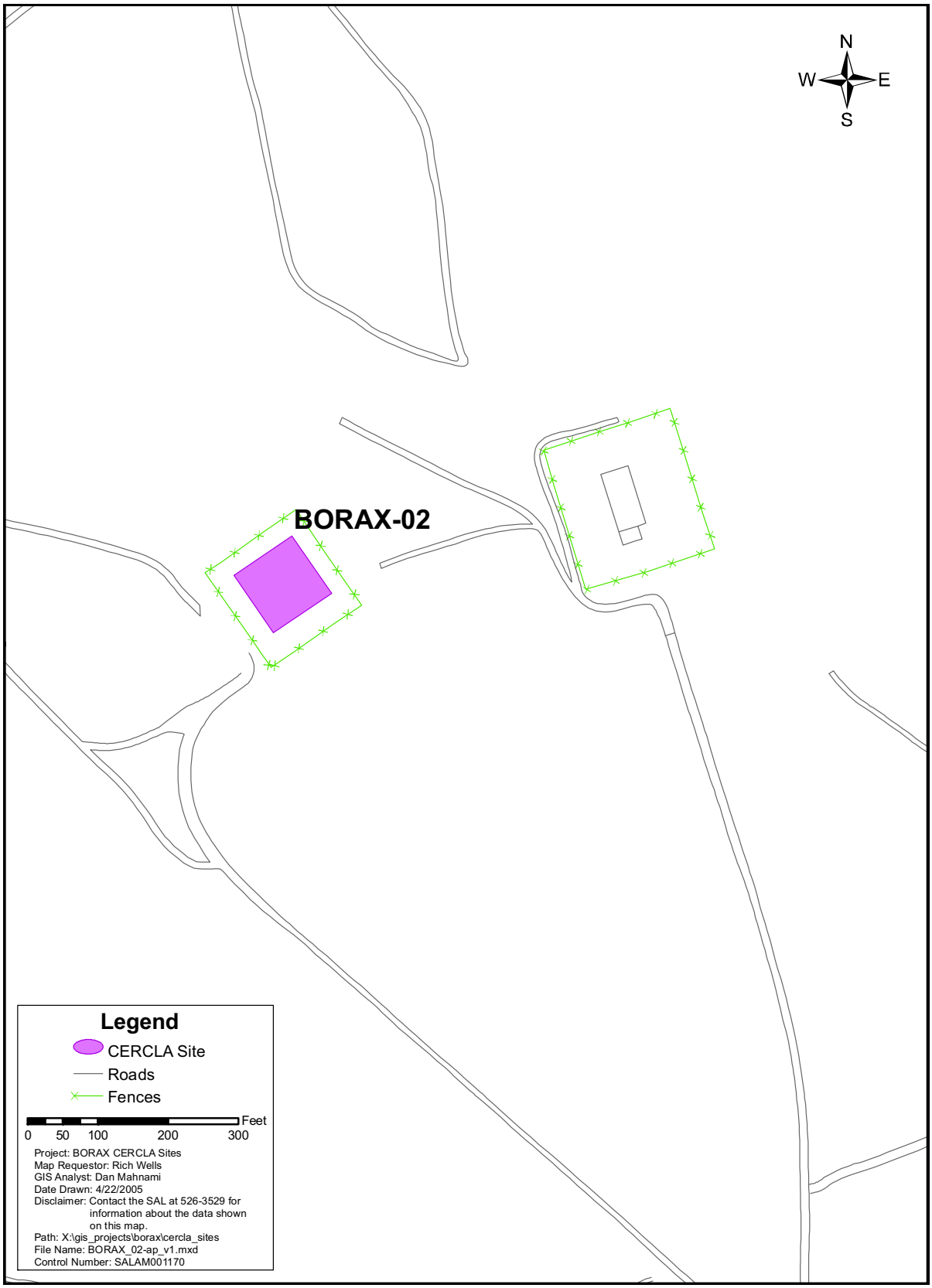


Figure 9-2. BORAX-02 burial ground.

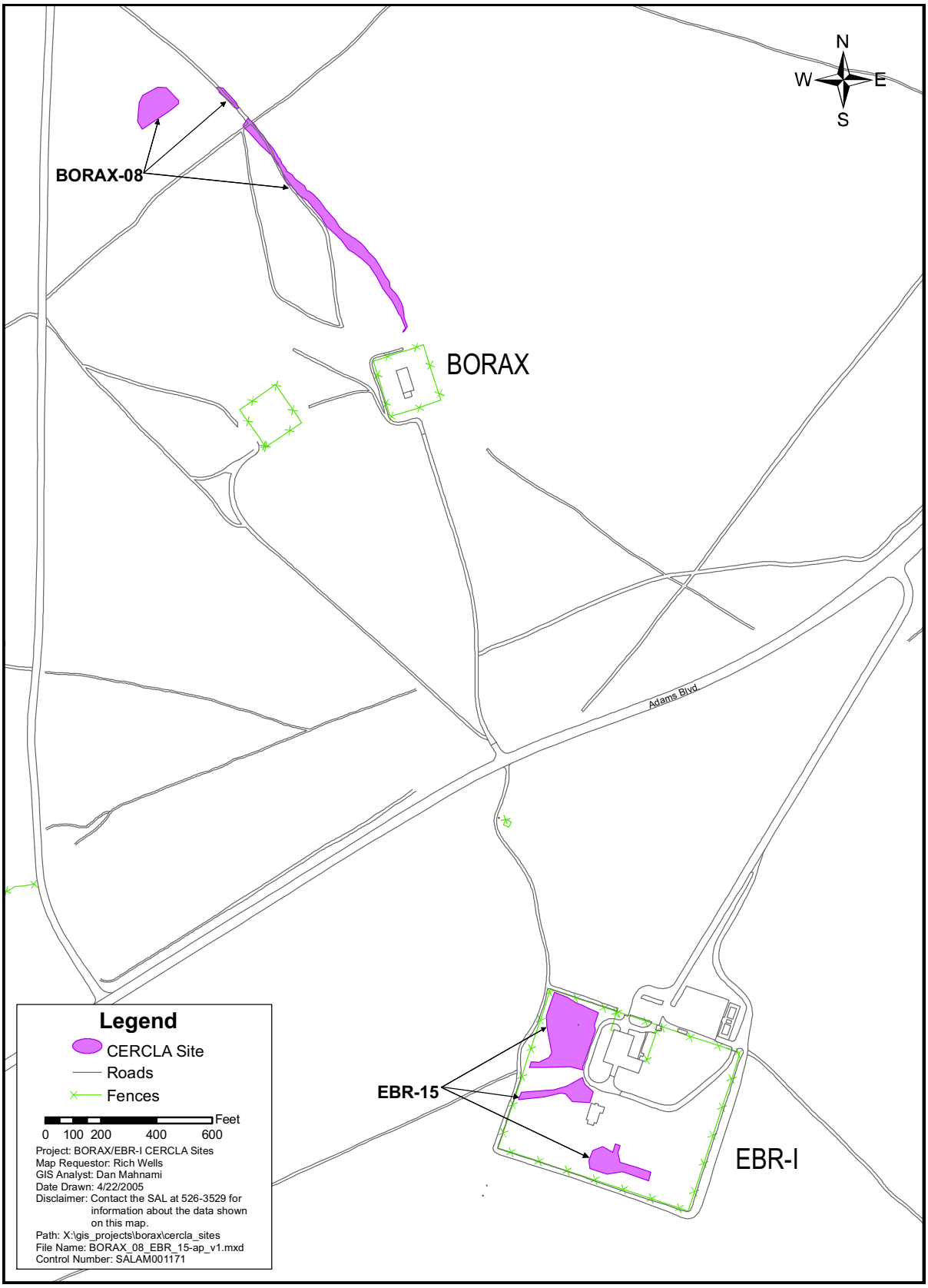


Figure 9-3. BORAX-08 and EBR-15.

Table 9-2. Chronology of WAG 6 events.

Event	Date
Construction of EBR-I was completed.	1951
Operation of the EBR-I reactor began.	August 24, 1951
The first electricity from nuclear power was generated at EBR-I.	December 20, 1951
EBR-I scientists proved the breeder reactor concept.	1953
Construction of BORAX-I was completed.	1953
BORAX-I was intentionally destroyed.	July 1954
Construction of BORAX-II was completed.	1954
Operation of the BORAX-II reactor began.	October 19, 1954
BORAX-II operation was shut down.	March 1955
Operation of the BORAX-III reactor began.	June 9, 1955
BORAX-III became the first reactor to provide electricity to a city (i.e., Arco, Idaho).	July 17, 1955
BORAX-III was shut down.	1956
Operation of the BORAX-IV reactor began.	December 3, 1956
BORAX-IV was shut down.	June 1958
Operation of the BORAX-V reactor began.	February 9, 1962
ERB-I operations ceased.	December 30, 1963
BORAX-V was shut down.	September 1964
EBR-I was dedicated as a Registered National Historic Landmark.	August 26, 1966
EBR-I was dedicated as a National Historic Mechanical Engineering Landmark.	1979
EBR-I was dedicated as a Historic Landmark for Advances in Materials Technology.	1979
The BORAX leach pond was backfilled with clean dirt.	1985
EBR-I was dedicated as a Nuclear Historic Landmark.	1987
The *Remedial Investigation/Feasibility Study Report for Operable Units 5-05 and 6-01 (SL-1 and BORAX-I Burial Grounds)* (INEL 1995b) was completed.	March 1995
The *Engineering Evaluation/Cost Analysis for Operable Unit 10-06 Radionuclide-Contaminated Soils Removal Action at the Idaho National Engineering Laboratory* (INEL 1995a) was completed.	June 1995
The non-time-critical removal action fieldwork at BORAX-08 was completed.	September 18, 1995
The *Record of Decision for Stationary Low-Power Reactor-1 and Boiling Water Reactor Experiment-I Burial Grounds (Operable Units 5-05 and 6-01) and 10 No Action Sites (Operable Units 5-01, 5-03, 5-04, and 5-11)* (INEL 1996a) was completed.	January 1996
The *Stationary Low-Power Reactor-1 and Boiling Water Reactor Experiment-I Burial Grounds Engineered Barriers Remedial Design/Remedial Action Scope of Work Operable Units 5-05 and 6-01* (INEL 1996b) was completed.	March 1996

Table 9-2. (continued).

Event	Date
The *Stationary Low-Power Reactor-1 and Boiling Water Reactor Experiment-I Burial Grounds Engineered Barriers Remedial Design/Remedial Action Work Plan, Operable Unit 5-05/6-01* (DOE-ID 1996) was completed.	April 1996
The BORAX-V decontamination, decommissioning, removal, and containment action was completed.	May 1997
The BORAX-I remedial action was completed.	1997
The *Remedial Action Report OU 5-05 Stationary Low-Power Reactor No. 1 and OU 6-01 Boiling Water Reactor Experiment-I Burial Grounds Engineered Barriers* (DOE-ID 1997) was completed.	October 1997
The *Comprehensive Remedial Investigation/Feasibility Study for Waste Area Groups 6 and 10 Operable Unit 10-04* (DOE-ID 2001) was completed.	August 2001
The *Record of Decision—Experimental Breeder Reactor-I/Boiling Water Reactor Experiment Area and Miscellaneous Sites, Operable Units 6-05 and 10-04* (DOE-ID 2002) was completed.	November 2002
The *Operable Units 6-05 and 10-04, Experimental Breeder Reactor-I/Boiling Water Reactor Experiment Area and Miscellaneous Sites, Remedial Design/Remedial Action Scope of Work* (DOE-ID 2003) was completed.	February 2003
The *Remedial Design/Remedial Action Work Plan for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2004a) was completed.	February 2004
The *INEEL Sitewide Institutional Controls Plan* (DOE-ID 2004b) was completed.	June 2004
The *Remedial Action Report for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2005) was completed.	January 2005

9.1.1.3 Institutional Controls. Signed in November 2002, the *Record of Decision—Experimental Breeder Reactor-I/Boiling Water Reactor Experiment Area and Miscellaneous Sites, Operable Units 6-05 and 10-04* (DOE-ID 2002) provided for implementation of institutional controls at selected WAG 6 no-further-action sites (Figure 9-4). Institutional controls are required at four BORAX sites, because Cs-137 concentrations exceed risk-based levels for the 100-year future residential scenario. The risk at Site EBR-08 is attributed to the presence of diesel. A brief description of the objectives of the institutional controls for each of the WAG 6 sites is provided below:

- **BORAX-II through -V Leach Pond (Site BORAX-01)**—Prevent exposure to contaminated soil, and control land use as industrial until discontinued based on the results of a five-year review.
- **BORAX-I Burial around (Site BORAX-02)**—Maintain the integrity of the containment barrier. Establish visible access restrictions, and control drilling and excavation.
- **BORAX Ditch (Site BORAX-08)**—Prevent exposure to contaminated soil, and control land use as industrial until discontinued based on the results of a five-year review.
- **BORAX-II through -V (Site BORAX-09)**—Maintain the integrity of the containment barrier. Establish visible access restrictions, and control drilling and excavation.
- **EBR-01 Fuel Oil Tank (Site EBR-08)**—Prevent exposure to contaminated soil. Establish visible access restrictions, and control drilling and excavation.

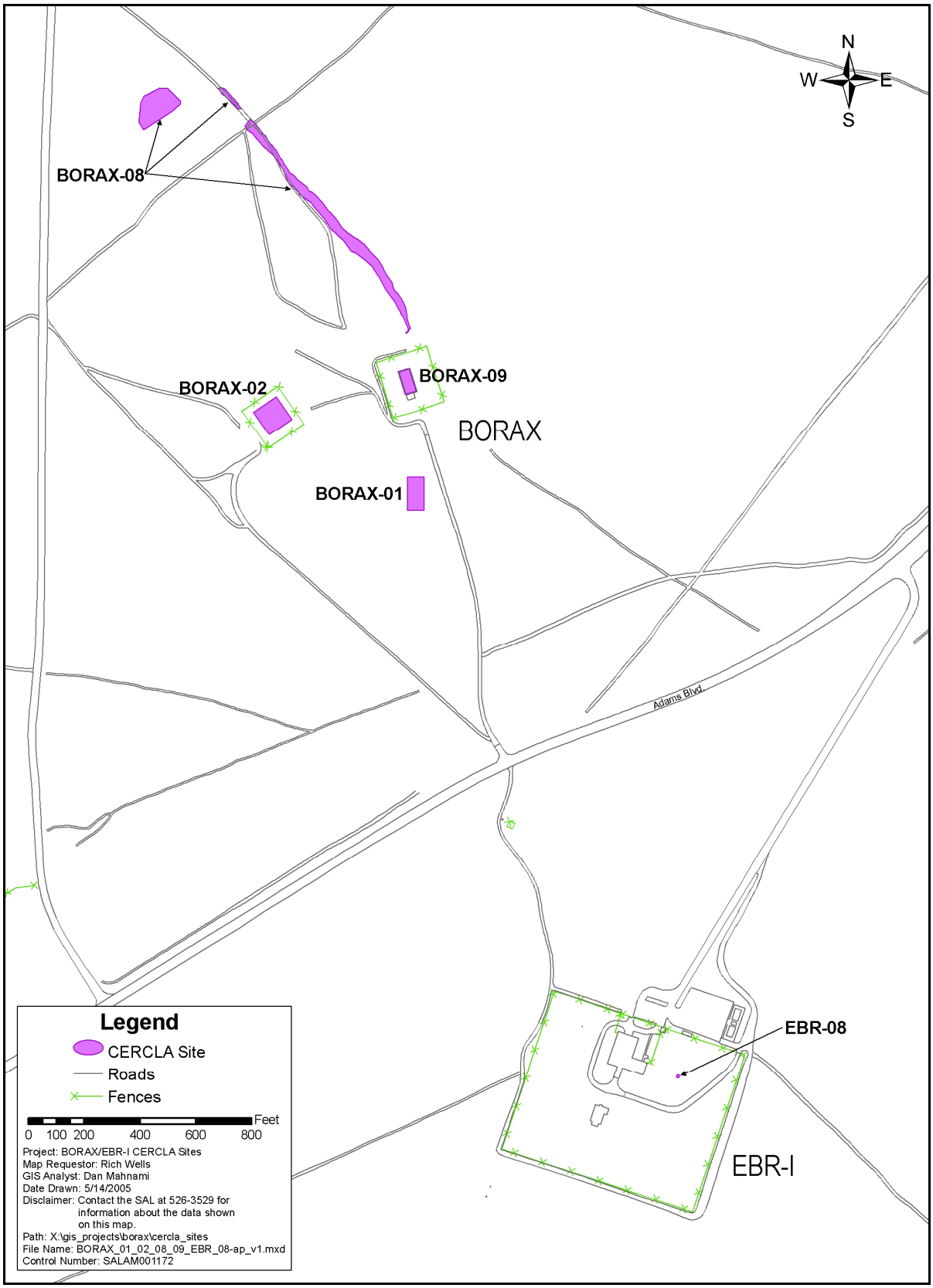


Figure 9-4. WAG 6 institutional control sites.

The ROD (DOE-ID 2002) also mandated development of a comprehensive approach for establishing, implementing, enforcing, and monitoring institutional controls at CERLA sites in accordance with U.S. Environmental Protection Agency (EPA) Region 10 policy (EPA 1999).

In accordance with the requirements delineated in the *Remedial Design/Remedial Action Work Plan for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2004a), institutional controls were implemented at the five sites listed in 2004. The results from the OU 10-04 Phase I activities are documented in the *Remedial Action Report for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2005).

9.1.2 Remedial Action Objectives

9.1.2.1 BORAX-I Burial Ground (Site BORAX-02). Results of the remedial investigation and baseline risk assessment indicated that exposure to penetrating radiation from contaminated soils and materials within the burial ground presented the most significant future risk to human health. Therefore, the primary remedial action objectives (RAOs) and the focus of the remedial action alternative development were to inhibit exposure to radioactive materials. RAOs established for protection of human health were as follows:

- Inhibit exposure to radioactive materials that would result in a total excess cancer risk (for all contaminants) of greater than 1 in 10,000 to 1 in 1,000,000 (1E-04 to 1E-06).
- Inhibit ingestion of radioactive materials that would result in a total excess cancer risk (for all contaminants) of greater than 1 in 10,000 to 1 in 1,000,000 (1E-04 to 1E-06).
- Inhibit inhalation of suspended radioactive materials that would result in a total excess cancer risk (for all contaminants) of greater than 1 in 10,000 to 1 in 1,000,000 (1E-04 to 1E-06).
- Inhibit degradation of the burial ground that could result in exposure of buried wastes or migration of contaminants to the surface that would pose a total excess cancer risk (for all contaminants) of greater than 1 in 10,000 to 1 in 1,000,000 (1E-04 to 1E-06).

The RAO for protection of the environment focuses on preservation of the local ecology by inhibiting the potential for contaminant migration. The RAO established for protection of the environment was to inhibit adverse effects to resident species from exposure to contaminants at the burial ground.

9.1.2.2 BORAX Ditch (Site BORAX-08) and Radioactive Soil Contamination at EBR-I (Site EBR-15). The RAOs for these sites were based on the results of the human health and ecological baseline risk assessments and were specific to the COCs and exposure pathways identified for the sites. RAOs for protecting the environment were not required for the radioactive soil contamination at EBR-I, because the area was found to be protective of the environment. The recommended RAOs are presented in Table 9-3.

9.1.3 Remedy Implementation

9.1.3.1 BORAX-I Burial Ground (Site BORAX-02). The remedial action for the burial ground was done in accordance with the requirements delineated in the *Stationary Low-Power Reactor-1 and Boiling Water Reactor Experiment-I Burial Grounds Engineered Barriers Project Remedial Design/Remedial Action Work Plan, Operable Unit 5-05/6-01* (DOE-ID 1996). The remedial action began in July 1996 with the removal of all shrubs, roots, signs, fencing, and other debris from the contaminated area for consolidation on top of the original 100- × 100-ft burial ground. Soil areas with radionuclide contamination exceeding the action levels were excavated to a depth of 1 ft and placed over the original

Table 9-3. Non-time-critical removal action RAOs.

Site	Environmental Media	RAO
BORAX-08	Soil	Prevent direct exposure to radiation posing excess cancer risk levels of 1E-04.
		Prevent adverse effects to resident populations (as determined by the ecological risk assessment) from soil or air containing COCs from the BORAX ditch.
		Limit release of metals from the site by migration caused by infiltrating precipitation.
		Prevent erosion that might result in the release of contaminated soils.
		Limit biotic intrusion into contaminated ditch soils that could facilitate erosion or the release of contaminated soil.
	Groundwater	Prevent ingestion of groundwater in excess of maximum contaminant levels and a total cancer risk of 1E-04 for metals only.
EBR-15	Soil	Prevent direct exposure to radiation posing excess cancer risk levels of 1E-04.
	Groundwater	Prevent ingestion of groundwater posing excess cancer risk levels of 1E-04 to 1E-06.
	Food crops	Prevent ingestion of contaminated food crops posing excess cancer risks of 1E-04 (Areas B, 7, 8, 9, 11a, and 11b).

burial ground in 6-in. lifts. A human intrusion barrier consisting of basalt riprap was constructed over the consolidated soils. A chain-link fence was installed around the burial ground with "Keep Out" and CERCLA identification signs, and two granite monuments were installed to warn potential future intruders. Results of the remedial action are documented in the *Remedial Action Report OU 5-05 Stationary Low-Power Reactor No. 1 and OU 6-01 Boiling Water Reactor Experiment-I Burial Grounds Engineered Barriers* (DOE-ID 1997).

9.1.3.2 BORAX Ditch (Site BORAX-08) and Radioactive Soil Contamination at EBR-I (Site EBR-15). The total volume of soil excavated from Site EBR-15 was 1,280 yd^3, with an average excavation depth of 12.5 in. The radionuclide-contaminated soil was transported in covered dump trucks to the Reactor Technology Complex (RTC) (formerly the Test Reactor Area) warm waste pond for disposal. The total volume excavated from Site BORAX-08 was 1,180 yd^3, focusing on Cs-137 as the COC with a preliminary remediation goal of 16.7 pCi/g. Again, the radionuclide-contaminated soil was disposed of in the RTC warm waste pond.

9.2 Data Evaluation

9.2.1 Site Inspections

Operations, maintenance, and institutional control inspections are conducted annually at WAG 6 sites. The following paragraphs summarize the results of annual inspections conducted at WAG 6 within the timeframe of this five-year review.

Inspections of institutional controls were required within six months of the ROD being signed and were completed in March 2003 (INEEL 2003). No deficiencies were identified during the 2003

inspection; however, all five sites were posted with "Environmentally Controlled Area" signs, which needed to be replaced with the standardized institutional controls sign. Signs were replaced during the spring of 2004. Institutional control inspections were conducted again in June 2004 (DOE-ID 2004c). Visible access restrictions, activity control, and land-use restrictions were evaluated, and no deficiencies were identified.

Operations and maintenance activities at WAG 6 consist of annual inspections of Site BORAX-02 for evidence of intrusion, settling, erosion, and, at the perimeter of the covers, radioactive contaminant migration. Annual inspections showed that the engineered covers are functioning as designed, with no sign of erosion, subsidence, or animal intrusion.

9.2.2 BORAX-I Burial Ground (Site BORAX-02)

The Cs-137 analytical results for the excavated areas had a mean of 1.43 pCi/g, with a 95% upper confidence limit (UCL) of 7.2 pCi/g based on a gamma distribution of the data. Only one of the zones requiring excavation exceeded the remediation goal for U-235, with a concentration of 15 pCi/g. After excavation, the maximum concentration was 8.2 pCi/g. The Sr-90 concentrations for the excavated areas ranged from 0.9 pCi/g to 85 pCi/g, with an average of 12.4 pCi/g and a median of 1.3 pCi/g. The 95% Chebyshev UCL for the Sr-90 data set is 52.2 pCi/g, which exceeds the remediation goal. The data set is largely skewed because of the single high data point of 85 pCi/g. If this point is omitted from consideration, the minimum remains 0.9 pCi/g, with a maximum of 8.1 pCi/g, an average of 3.35 pCi/g, and a median of 1.25 pCi/g. The 95% Chebyshev UCL for this modified data set is 8.23 pCi/g, which is within the specified remediation goal.

9.2.3 BORAX Ditch (Site BORAX-08)

Based on the verification sampling data provided the *Comprehensive Remedial Investigation/Feasibility Study for Waste Area Groups 6 and 10 Operable Unit 10-04* (DOE-ID 2001), the residual Cs-137 concentrations at Site BORAX-08 ranged from 0.1 to 8.1 pCi/g, with an average concentration of 1.2 pCi/g and a 95% UCL concentration of 2.75 pCi/g based on a gamma distribution for the data set. Based on the revised preliminary remediation goals as provided by EPA and presented in Appendix A, the Cs-137 concentration required for free release is 5.97 pCi/g. Therefore, institutional controls should no longer be required at BORAX-08.

9.3 Progress since Last Review

The BORAX-I burial ground (Site BORAX-02) is the only WAG 6 site to previously undergo a five-year review, which was conducted by the EPA (EPA 2001). The 1998 annual inspection report identified localized areas of potential contamination that were observed during the radiological survey of the area. Potential contamination of the burial ground was addressed in the WAG 10 comprehensive RI/FS (DOE-ID 2001), which did not confirm the potential contamination identified in the 1998 annual inspection report. The review showed that based on the most recent annual inspection, the engineered barrier appeared to be intact with no visible evidence of subsidence or erosion. There was no indication that weeds or shrubs were encroaching onto the engineered barrier and no indication of other biointrusion. The revegetated area showed no indication of soil movement or erosion, and the grass appeared to be well established. Results of radiological surveys were consistent with those obtained historically after the remedial action. The EPA staff visually inspected the site on July 16, 2001, and observations were consistent with the annual report.

9.3.1 Issues Identified during the First Five-Year Review

The first five-year review report noted that according to the June 2001 annual inspection, the CERCLA sign at Site BORAX-02 needed to be updated to correctly state the existing dimensions of the perimeter fence. It was recommended that the next review for the site be coordinated with the next statutory sitewide five-year review. It was also noted that the observation of contamination at the burial ground so soon after completion of the remedial action was cause for concern, but there was no indication of failure of the engineered barrier. The early appearance of contamination, the proximity of exposed surface contamination areas, and the fact that the radiological surveys were similar from year to year suggested windblown cross contamination as a likely source of the observed contamination.

9.3.2 Response Actions to Issues Identified during the First Five-Year Review

The only issue identified in the first five-year review requiring attention was to replace the CERCLA sign with an updated version. As part of the OU 6-05 and 10-04 Phase I remedial action, the CERCLA sign was replaced to comply with the current specifications in the *INEEL Sitewide Institutional Controls Plan* (DOE-ID 2004b). That action was documented in the *Remedial Action Report for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2005).

It was also determined that the residual risk associated with the site needed to be addressed, although it was not required as a result of the first five-year review of the burial ground (Site BORAX-02) remedial action. As discussed in the 2002 annual inspection report, BORAX-02 was assessed for the nature and extent of the radiological contamination that remains outside the engineered barrier at the site. Upon review of the available data, the data from the 1998 Global Positioning Radiometric Scanner survey were selected for use in the risk assessment. The Cs-137 data were corrected for the shielding provided by the 6-in. gravel layer and for radioactive decay to May 2002. Historical data were used to establish ratios of Sr-90 and U-235 to Cs-137 in order to estimate the concentrations of the two isotopes. Based on this approach, the average Cs-137, U-235, and Sr-90 concentrations for the site using exposure point concentrations for nine discrete areas were 51.56 pCi/g, 2.98 pCi/g, and 12.57 pCi/g, respectively.

The assessment was performed using two methods, the RESidual RADioactivity (RESRAD) modeling and the standard baseline risk assessment methodology presented in the OU 10-04 comprehensive RI/FS (DOE-ID 2001). The results of the assessment showed that the dose to current and future receptors is acceptable at the BORAX-02 site, although two areas of contamination might exceed risk-based concentrations (1E-04). This risk, however, is considered acceptable based on the uncertainties associated with the analysis and combined with the understanding that the residual Cs-137 activity at the site will decay to acceptable risk levels in approximately 130 years.

9.4 Technical Assessment

Question A: *Is the remedy functioning as intended by the decision documents?*

The Cs-137 and U-235 confirmation sample results for the BORAX-02 site remediated under OU 6-01 were within the specified remediation goals, but the Sr-90 results are questionable because of the single high result. The site does not pose an unacceptable risk to human health or the environment, given the results of the risk assessment performed in 2002 to address residual contamination at the site (EDF-2208). Disregarding the single high result for SR-90, the 95% UCL for Sr-90 was 8.23 pCi/g, which is within the remediation goal of 10.8 pCi/g. The engineered cover is intended to provide shielding from ionizing radiation, prevent human intrusion, and contain the contaminated surface soils. The annual inspections validated the structural integrity of the cover. Based on this five-year review, the remedy and

protective measures implemented at the BORAX-I burial ground (Site BORAX-02) are functioning as intended.

The OU 6-05 ROD (DOE-ID 2002) required implementation of institutional controls at five sites. Based on this five-year review, the institutional controls are in place and functioning as required.

The non-time-critical removal actions completed at Sites EBR-15 and BORAX-08 were successful in removing contaminated soil that exceeded the prescribed remediation goals. For the two sites, the 95% UCL for the residual Cs-137 contamination was 3.17 pCi/g and 2.75 pCi/g, respectively, as compared to the remediation goal of 16.7 pCi/g. Based on these concentrations, the remediation of the two sites was successful.

Question B: *Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?*

None of the COCs has undergone any major revision in the toxicological criteria since the development of the final remediation goals that would decrease these goals. In fact, based on the EPA guidance of 2001 as presented in Appendix A, the Cs-137 remediation goals have increased. Therefore, once met, the final remediation goals (site-specific risk-based cleanup levels) will remain protective of human health and the environment under current exposure scenarios.

The original assumptions, cleanup levels, and RAOs used at the time of the remedy selection are still valid.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?*

No new information that would call into question the protectiveness of the implemented remedies has surfaced while compiling and reviewing the inspections, radiological survey, and confirmation sampling analytical data.

9.5 Technical Assessment Summary

Remedial actions have been completed at the BORAX-I burial ground, the BORAX ditch, and the radioactive soil contamination area at EBR-I. Based on the available data, the remedial actions at the sites were successful, and the remedies are functioning as intended. The exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selections are still valid, and no new information has come to light that could call into question the protectiveness of the remedies. In addition to the remediation of these three sites, institutional controls have been implemented and are functioning as required at five sites within WAG 6.

9.6 Issues

No issues were identified during the five-year review of the remedial actions conducted at WAG 6.

9.7 Recommendations and Follow-up Actions

The annual inspections and reports of institutional controls should be continued in accordance with the 1999 EPA Region 10 final policy on the use of institutional controls at federal facilities, as outlined in the *INEEL Sitewide Institutional Controls Plan* (DOE-ID 2004b). Radiological surveys at the BORAX-I burial ground should be continued to ensure that contamination levels are at or below those observed

historically. If any changes are identified that would call into question the integrity of the engineered barrier at the burial ground, a new baseline survey should be completed to identify the impact of the changes. Based on the preliminary remediation goals provided by EPA (see Appendix A), institutional controls are no longer required at BORAX-08.

9.8 Protectiveness Statement

The remedies completed at WAG 6 are functioning as intended. The physical conditions of the site have not changed in ways that would affect the protectiveness of the completed remedies, nor have the toxicity or risk factors changed in ways that would adversely impact the levels of COCs. There is no information that would call into question the protectiveness of the remedies performed.

9.9 Section 9 References

DOE-ID, 1991, *Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory*, Administrative Record No. 1088-06-29-120, U.S. Department of Energy Idaho Operations Office; U.S. Environmental Protection Agency, Region 10; Idaho Department of Health and Welfare, December 4, 1991.

DOE-ID, 1996, *Stationary Low-Power Reactor-1 and Boiling Water Reactor Experiment-I Burial Grounds Engineered Barriers Project Remedial Design/Remedial Action Work Plan, Operable Unit 5-05/6-01*, DOE/ID-10532, Rev. 0, U.S. Department of Energy Idaho Operations Office, April 1996.

DOE-ID, 1997, *Remedial Action Report OU 5-05 Stationary Low-Power Reactor No. 1 and OU 6-01 Boiling Water Reactor Experiment-I Burial Grounds Engineered Barriers*, DOE/ID-10591, Rev. 0, U.S. Department of Energy Idaho Operations Office, October 1997.

DOE-ID, 2001, *Comprehensive Remedial Investigation/Feasibility Study for Waste Area Groups 6 and 10 Operable Unit 10-04*, DOE/ID-10807, Rev. 0, U.S. Department of Energy Idaho Operations Office, August 2001.

DOE-ID, 2002, *Record of Decision—Experimental Breeder Reactor-I/Boiling Water Reactor Experiment Area and Miscellaneous Sites, Operable Units 6-05 and 10-04*, DOE/ID-10980, U.S. Department of Energy Idaho Operations Office, November 2002.

DOE-ID, 2003, *Operable Units 6-05 and 10-04, Experimental Breeder Reactor-I/Boiling Water Reactor Experiment Area and Miscellaneous Sites, Remedial Design/Remedial Action Scope of Work*, DOE/ID-11035, Rev. 0, U.S. Department of Energy Idaho Operations Office, February 2003.

DOE-ID, 2004a, *Remedial Design/Remedial Action Work Plan for Operable Units 6-05 and 10-04, Phase I*, DOE/ID-11101, Rev. 0, U.S. Department of Energy Idaho Operations Office, February 2004.

DOE-ID, 2004b, *INEEL Sitewide Institutional Controls Plan*, DOE/ID-11042, Rev. 1, U.S. Department of Energy Idaho Operations Office, June 2004.

DOE-ID, 2004c, *INEEL Sitewide Institutional Controls Annual Report-FY 2004*, DOE/NE-ID-11180, Rev. 0, U.S. Department of Energy Idaho Operations Office, September 2004.

DOE-ID, 2005, *Remedial Action Report for Operable Units 6-05 and 10-04, Phase I*, DOE/NE-ID-11186, Rev. 0, U.S. Department of Energy Idaho Operations Office, January 2005.

EDF-2208, 2002, "Engineering Design File – Risk Assessment for the Residual Radiological Contamination at the BORAX I Reactor Burial Site, CERCLA Site BORAX-02, OU 6-10," Rev. 1, Idaho National Engineering and Environmental Laboratory, December 2002.

EPA, 1999, "Region 10 Final Policy on the Use of Institutional Controls at Federal Facilities," Office of Environmental Cleanup, Office of Waste and Chemicals Management, and Office of Regional Counsel, U.S. Environmental Protection Agency, Seattle, Washington, September 2000.

EPA, 2001, "Idaho National Engineering Laboratory SL-1/BORAX-I Burial Grounds Remedial Action Review," Document No. 24742, U.S. Environmental Protection Agency Region 10, August 17, 2001.

INEEL, 2003, *Institutional Controls Status Report for Waste Area Groups 6 and 10*, INEEL/EXT-03-00199, Rev. 0, Idaho National Engineering Laboratory, April 2003.

INEL, 1995a, *Engineering Evaluation/Cost Analysis for Operable Unit 10-06 Radionuclide-Contaminated Soils Removal Action at the Idaho National Engineering Laboratory*, INEL-95/0259, Rev. 0, Idaho National Engineering Laboratory, June 1995.

INEL, 1995b, *Remedial Investigation/Feasibility Study Report for Operable Units 5-05 and 6-01 (SL-I and BORAX-I Burial Grounds)*, INEL-95/0027, Rev. 0, Idaho National Engineering Laboratory, March 1995.

INEL, 1996a, *Record of Decision for Stationary Low-Power Reactor-1 and Boiling Water Reactor Experiment-I Burial Grounds (Operable Units 5-05 and 6-01) and 10 No Action Sites (Operable Units 5-01, 5-03, 5-04, and 5-11)*, INEL-95/0282, Idaho National Engineering Laboratory, January 1996.

INEL, 1996b, *Stationary Low Power Reactor-1 and Boiling Water Reactor Experiment-I Burial Grounds Engineered Barriers Remedial Design/Remedial Action Scope of Work, Operable Units 5-05 and 6-01*, INEL-95/0456, Rev. 0, Idaho National Engineering Laboratory, March 1996.